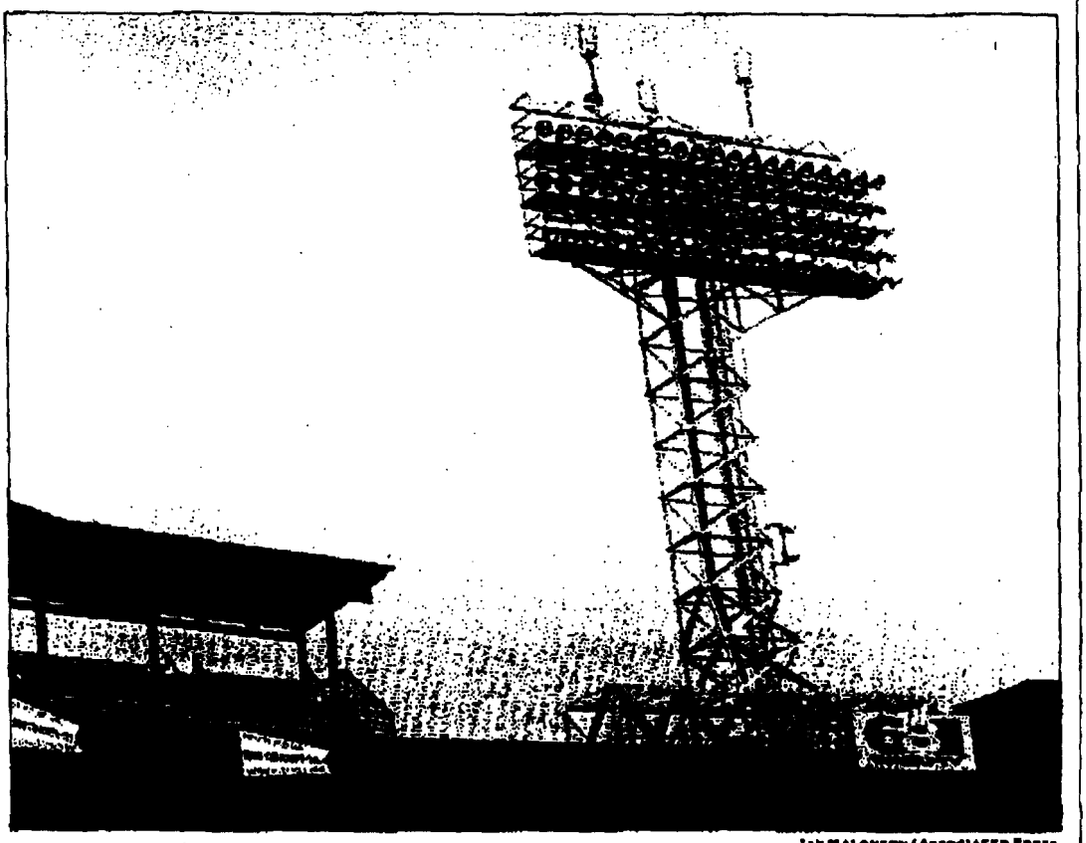
"Cellular towers go undercover," Seattle Times, July19, 1996 page D1

Lights, trees, steeples help ease opposition to antennas



JAY MALONSON / ASSOCIATED PRESS

Cellular-phone companies *are disguising unsightly transmitters in fixtures such as the lights at Fenway Park in Boston.*

Cellular towers go undercover

BY JON MARCUS
Associated Press

BOSTON — The steeple of the United Methodist Church in the scenic coastal town of Ipswich reaches out and touches more than just the heavens — it's also a cellular-phone transmitter.

Same goes for a plastic tree near George Washington's Mount Vernon estate in Virginia, a flag pole in Pittsburgh and even the lights over the left-field wall at Fenway Park, home of the Boston Red Sox.

Phone companies anxious to expand service without angering communities defensive about their history and architecture are concealing their antenna towers anywhere they can and paying rent for the rights.

"The industry is being forced, frankly due to strict zoning and community concerns, to be more innovative in the way they camouflage these towers," said Duncan Milloy, a spokesman for Bell Atlantic Nynex Mobile.

When Ipswich rejected a proposal for a tall antenna tower in the town, Bell Atlantic offered to build a replica of the lightning-damaged, 1859 church steeple in exchange for the right to hide a transmitter inside.

"They get to replace a steeple that they otherwise may never have been able to replace," said Mike Moscaritolo, Bell Atlantic's regional director of network engineering. "The town wins. And we win."

There are about 22,000 cellular transmitters in the United States, though more than one may share the same tower. An additional 100,000 are expected to be needed by the end of this decade to satisfy the demand for cellular service.

Depending on the elevation of the land, the transmitters generally stand 60 to 400 feet tall and can be as little as a mile apart in densely populated areas or up to six miles apart in rural sections.

"Given the requirement to reuse the same set of frequencies over and over again, you have to have multiple places to put up your antennas," said Mark Faris, vice president for network engineering operations at Cellular One.

Cellular One disguised a 100-foot relay tower as a plastic and rubber "pine tree" near Washington's estate. The company also has hidden panel antennas painted green around the upper deck of Camden Yards, home of the Baltimore Orioles, and behind the American flag at USAir Arena in Landover, Md., where the Washington Bullets and Capitals play.

And in Washington, D.C., which has a building-height restriction, the company conceals its transmitters on billboards and in parking garages and church steeples.

FWT, a company in Fort Worth, Texas, conceals cellular-telephone antennas inside fiberglass palm trees 60 to 100 feet tall. "It is absolutely a growing industry," said Roy Moore, the company's vice president.

Finding lofty places and hiding transmitters and their power sources "makes a boring engineering job a little bit more fun," Faris said.

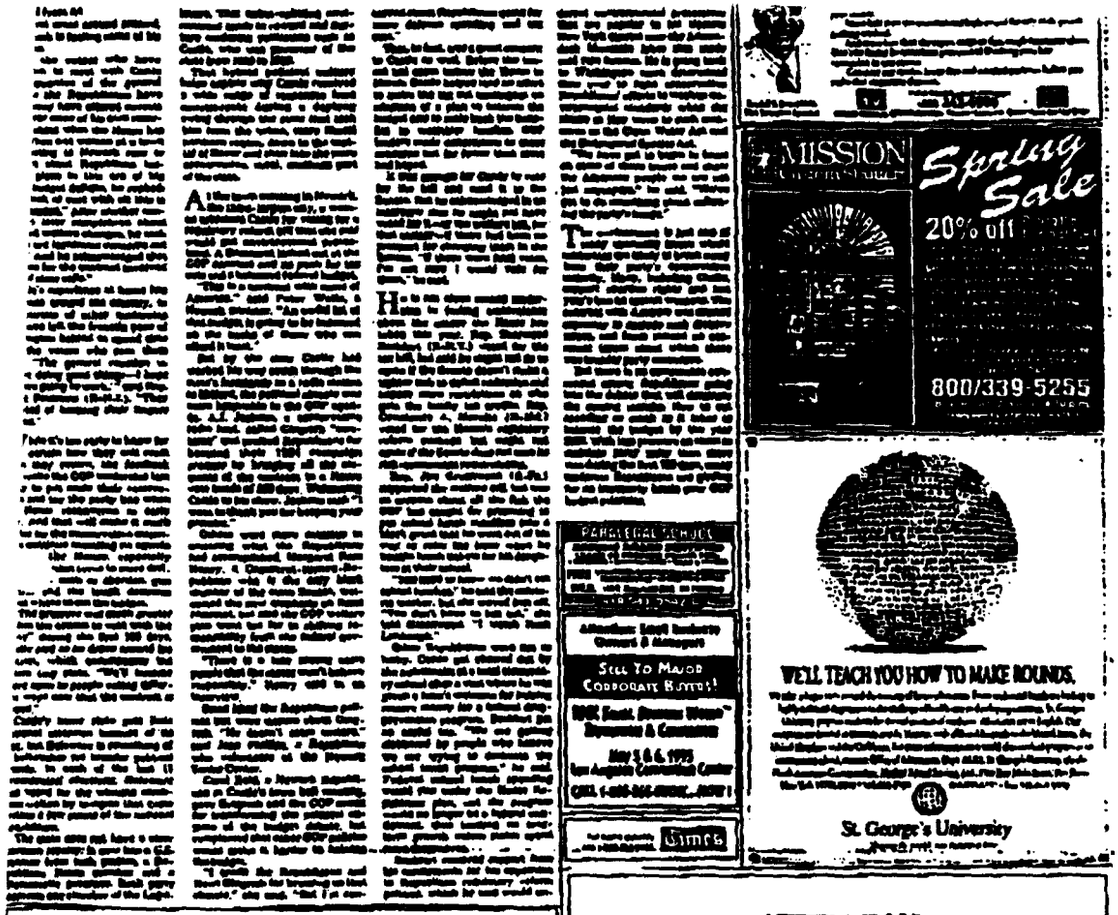
It also lowers the cost to the companies and provides extra revenue to churches, schools and other groups with buildings to offer. Some states are being pressed to lease their highway signs to cellular operators, and even the Postal Service is offering to rent out space for transmitters.

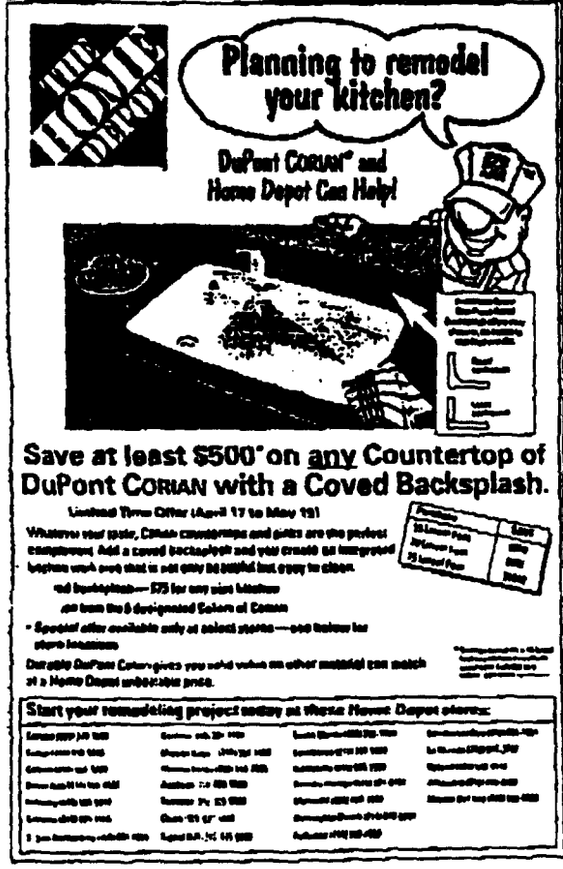
"It's a great idea," said Walter Johnson, a Chicago architect, expert in historic preservation and a fellow of the American Institute of Architects. "It saves us from a blight on the landscape."

April 16, 1995

Los Angeles Times

Pg A14





ATTENTION

The Los Angeles Cellular Telephone Company ("L.A. Cellular") has been investigated by the California Public Utilities Commission for the company's failure in some cases to comply fully with all of the Commission's rules and regulations for constructing cellular facilities. The Commission only authorizes construction of cellular facilities that have obtained all requisite permits and approvals from other government agencies.

L.A. Cellular reaffirms its commitment to providing the highest quality service throughout its service area and to complying with all federal, state and local laws, including giving the public required notice and an opportunity to be heard concerning construction of its facilities.

L.A. Cellular apologizes for any inconvenience its failure to comply fully may have caused the public authorities, L.A. Cellular's subscribers, and the public in general.

If you have any comments or concerns regarding this notice, please contact:

California Public Utilities Commission
Attn: Kent Wheatland
505 Van Ness Avenue
San Francisco, CA 94102

« Cellular Phone Notes »

The Cellular Telecommunications Industry Association's (CTIA) Scientific Advisory Group on Wireless Technology (SAG) has decided to defer a repeat of the **Lai–Singh** experiment which showed that 2.45 GHz radiation can cause single-strand DNA breaks in the brains of rats (see *MWN*, N/D94) until a SAG-approved exposure system is available. The decision was based at least in part on a review by the **Harvard Center for Risk Analysis'** cellular telephone advisory committee. However, the SAG appears to be ambivalent about whether to wait until a head-only exposure system is developed or until an international validation study of the comet assay used by Drs. Henry Lai and N.P. Singh is completed. In a February 8 letter to the SAG's Dr. George Carlo, the center's Dr. Susan Putnam wrote that, "The majority of the peer reviewers stated that the repetition of the [Lai–Singh study] should be deferred until an appropriate *in vivo* exposure system is developed. There was some concern expressed, however, that this would delay the program and that there was no reason to wait before beginning the replication process of the [Lai–Singh] study....The majority of the reviewers again stated that it would be prudent to wait until the international validation [was] completed before repeating the initial study. There were also several comments in disagreement with this, however. There was some concern over whether the international validation would be contributory to the issue and also concern that waiting would provide unnecessary delays to the program with little added benefit." Putnam told *Microwave News* that only six of the 11 members of the committee—Drs. Larry Anderson, Carl Durney, Saxon Graham, Asher Sheppard, Peter Valberg and Gary Williams—had responded to her request for comment, but she would not say what each had recommended. The four epidemiologists on the panel had not expressed opinions; neither had the committee's final member, Dr. Don Justesen. Since the panel was first announced last year (see *MWN*, J/A94), Dr. Philip Cole has resigned; very recently EPA's Dr. Joe Elder joined the group. The Harvard center would not release its report without Carlo's permission, and Carlo kept it confidential for six weeks. On March 23, Carlo released it as an attachment to a letter to FDA's Dr. Elizabeth Jacobson, in which he stated that, although the SAG would delay *in vivo* studies, it would release a request for proposals "within the next couple of weeks" for *in vitro* studies in "multiple laboratories." Carlo announced that, "Our goal is to have the initial *in vitro* work completed within the second quarter of this year." Mike Volpe, SAG's spokesperson, said that three labs will do the *in vitro* work: that of Dr. Martin Meltz of the University of Texas Health Sciences Center in San Antonio and two others to be selected from proposals received in response to the upcoming request. Volpe confirmed that the SAG expects to have experimental data in hand by the end of June. Carlo noted in his letter that the international validation study "may take several years" and that the *in vivo* work will begin "when the SAG's exposure system is available." In contrast to the SAG, Motorola has already initiated a repeat of the Lai–Singh *in vivo* study (see *MWN*, J/F95).

«« »»

The **Los Angeles Cellular Telephone Co.** (LACT) is paying the **California Public Utilities Commission** (PUC) $4.37 million to settle alleged violations of cellular tower siting rules. The PUC concluded that, "LACT knowingly and intentionally misled the commission by filing incorrect information," but felt that the intent behind the company's actions would be difficult to prove, according to a joint PUC–LACT statement. The settlement was also prompted by the fact that the investigation—which involved 150 LACT cell sites—would have required more than a year to litigate. The February 28 agreement gives LACT two years to bring its sites into compliance. The cellular phone company has also concluded an inquiry into an additional three sites for alleged "misrepresentation[s] to the PUC, premature construction and permitting deficiencies," with a settlement of approximately $725,000, according to Ira Alderson, an attorney with PUC's safety and enforcement division. Both settlements stem from a PUC investigation begun in 1992 to determine whether cellular companies had had the necessary state and local permits before beginning construction. "We suspected that there was a widespread practice of not following the steps required by the PUC," said Alderson. The first phase of the probe focused on LACT, the Bay Area Cellular Telephone Co. (BACT) and GTE Mobilnet of California. GTE Mobilnet was fined $343,000 for working on a site without permission and BACT was fined $2,000 for not submitting required permits to the PUC. GTE Mobilnet has appealed the decision. In the second phase, the PUC required all California cellular carriers to file detailed information regarding their compliance with siting rules. The commission is approximately halfway through this portion of the inquiry, Alderson said. Some companies, including McCaw Cellular Communications, now a subsidiary of AT&T, and Mountain Cellular, have already settled with the commission, he added. "I think that because of the investigations, cellular companies are trying to comply more," Alderson noted.

«« »»

In the latest in a series of progress reports, Dr. **George Carlo** and other members of the **CTIA's SAG** research effort briefed representatives of federal agencies at FDA's Center for Devices and Radiological Health on March 17 in Rockville, MD. After the meeting, one attendee said: "The epi work seems to be progressing, but the other studies are moving very slowly." Another commented that, "It's not only a question of speed, we don't know where they are going," adding that after the meeting, "We decided that the federal agencies needed to coordinate better." And a third attendee expressed concern that, "There isn't enough emphasis on cancer promotion studies." All those who offered their views asked for anonymity.

«« »»

U.K. defense experts have now ruled out **EMI** from a cellular phone as a potential cause of a **helicopter crash** that killed 24 top intelligence officers in Scotland last June, according to the February 5 edition of the U.K.'s *Sunday Express* (see

Cellular Power Density for the Edgewater Cell Site.

Prepared by Roy Norgaard 10/11/94

Antenna Height: 35 feet ERP/Chan: 100 watts
Measurement Ht: 6 feet Antenna: DB 833R
Number of Radio Chs 30

Distance From Tower (Feet)	Adjusted Vertical Elevation (Feet)	Angle Below Horizon (degrees)	Antenna Vertical Pattern (dB)	Distance From Antenna (Feet)	Channels Power Density (uW/cm^2)	% of Revised ANSI Standard (580uW/cm^2)	Comments:
0	0	90.0	-29.0	29.0	1.666	0.2868%	
5	0	80.2	-29.0	29.4	1.621	0.2747%	
10	0	71.0	-29.0	30.7	2.978	0.5044%	
20	0	55.4	-17.0	35.2	17.924	3.0903%	
30	10	32.3	-11.5	36.5	62.585	10.8081%	2nd floor of adj apartment
40	0	35.9	-10.8	49.4	38.427	6.5131%	1st floor of adj apartment
50	0	30.1	-12.5	57.8	18.784	3.1864%	
60	0	25.8	-19.0	66.6	3.180	0.5386%	
70	0	22.5	-12.3	76.8	11.435	1.9381%	
80	0	19.9	-9.0	85.1	19.382	3.2861%	
90	0	17.9	-7.0	94.9	24.879	4.2167%	
100	0	16.2	-6.1	104.1	26.535	4.4969%	
110	0	14.8	-4.8	113.8	30.586	5.1857%	
120	0	13.6	-3.9	123.5	29.799	5.0524%	
130	0	12.6	-3.1	133.2	31.135	5.2789%	
140	0	11.7	-2.5	143.0	30.669	5.1962%	
150	0	10.9	-2.0	152.8	30.139	5.1078%	
160	0	10.3	-2.0	162.6	28.603	4.8477%	
170	0	9.7	-1.8	172.5	26.052	4.4149%	
180	0	9.2	-1.6	182.3	22.415	3.7991%	
190	0	8.7	-1.3	192.2	22.372	3.7918%	
200	0	8.3	-1.3	202.1	20.236	3.4297%	
225	0	7.3	-0.9	226.9	17.607	2.9844%	
250	0	6.6	-0.8	251.7	14.639	2.4812%	
275	0	6.0	-0.6	276.5	12.127	2.0554%	
300	0	5.5	-0.3	301.4	11.463	1.9427%	
325	0	5.1	-0.3	326.3	9.772	1.6563%	
350	0	4.7	-0.1	351.2	8.833	1.4971%	
375	0	4.4	-0.1	376.1	7.701	1.3053%	
400	0	4.1	-0.1	401.0	6.775	1.1483%	
450	0	3.7	0.0	450.9	5.483	0.9293%	
500	0	3.3	0.0	500.8	4.444	0.7532%	
600	0	2.8	0.0	600.7	3.060	0.5186%	
700	0	2.4	0.0	700.6	2.271	0.3849%	
800	0	2.1	0.0	800.6	1.740	0.2949%	
900	0	1.8	0.0	900.5	1.375	0.2330%	
1000	0	1.7	0.0	1000.4	1.114	0.1888%	
1500	0	1.1	0.0	1500.3	0.496	0.0840%	
2000	0	0.8	0.0	2000.2	0.279	0.0473%	
2500	0	0.7	0.0	2500.2	0.178	0.0302%	
3000	0	0.6	0.0	3000.1	0.124	0.0210%	
4000	0	0.4	0.0	4000.1	0.070	0.0118%	
5000	0	0.3	0.0	5000.1	0.045	0.0076%	

Assumptions:

1.) "B-Band" Cellular Transmitter Frequencies are 880.02 to 893.85 MHz.

2.) All exposures will be in the far-field region since the longest wavelength is 14 inches.

3.) Exposures include 64% reflected energy from the ground.

4.) Calculations are worst cases based on theoretical antennas that provide maximum gain for 360 degrees in the horizontal plane.

Cellular Power Density for the Laurelhurst Cell Site.

Prepared by Roy Norgaard 11/07/94

Antenna Height: 45 feet ERP/Chan: 100 watts
Measurement Ht: 6 feet Antenna: DB 833R
Number of Radio Chs 30

Distance From Tower (Feet)	Adjusted Vertical Elevation (Feet)	Angle Below Horizon (degrees)	Antenna Vertical Pattern (dB)	Distance From Antenna (Feet)	Channels Power Density (uW/cm^2)	% of Revised ANSI Standard (600uW/cm^2)	Comments:
0	0	90.0	-29.0	39.0	0.923	0.1584%	
5	0	82.7	-29.0	39.3	0.909	0.1539%	
10	0	75.8	-28.9	40.3	1.420	0.2408%	
20	0	82.9	-20.1	43.8	5.671	0.9612%	
30	0	62.4	-15.3	49.2	13.580	2.3033%	
40	0	44.3	-12.2	55.9	21.523	3.6480%	stores along Sand Point Way
50	0	38.0	-10.7	63.4	23.871	4.0459%	stores along Sand Point Way
60	0	33.0	-11.1	71.6	16.899	2.8642%	
70	0	29.1	-13.8	80.1	7.238	1.2267%	
80	0	26.0	-19.0	89.0	1.772	0.3003%	
90	0	23.4	-14.0	98.1	4.613	0.7819%	
100	0	21.3	-11.1	107.3	7.511	1.2731%	
110	0	19.5	-9.0	116.7	10.304	1.7464%	
120	0	18.0	-8.0	126.2	11.098	1.8810%	
130	0	16.7	-8.1	135.7	15.028	2.5471%	
140	0	15.6	-8.2	145.3	15.940	2.7017%	
150	0	14.6	-4.5	155.0	16.457	2.7810%	
160	0	13.7	-3.9	164.7	16.745	2.8382%	
170	0	12.9	-3.1	174.4	18.157	3.0774%	Thriftway parking lot
180	0	12.2	-3.1	184.2	16.263	2.7566%	
190	0	11.6	-2.5	194.0	16.664	2.8244%	
200	0	11.0	-2.5	203.8	15.009	2.5501%	
225	0	9.8	-1.8	228.4	14.269	2.4218%	
250	0	8.9	-1.3	253.0	12.909	2.1879%	
275	0	8.1	-1.3	277.8	10.713	1.8157%	
300	0	7.4	-0.9	302.5	9.901	1.6782%	
325	0	6.8	-0.8	327.3	8.654	1.4668%	
350	0	6.4	-0.8	352.2	7.477	1.2672%	
375	0	5.9	-0.3	377.0	7.319	1.2405%	
400	0	5.6	-0.2	401.9	6.441	1.0918%	
450	0	5.0	-0.1	451.7	5.340	0.9051%	
500	0	4.5	-0.1	501.6	4.331	0.7341%	
600	0	3.7	0.0	601.3	3.084	0.5227%	
700	0	3.2	0.0	701.1	2.268	0.3844%	
800	0	2.8	0.0	801.0	1.736	0.2942%	
900	0	2.5	0.0	900.8	1.374	0.2329%	
1000	0	2.2	0.0	1000.6	1.113	0.1887%	
1500	0	1.5	0.0	1500.6	0.486	0.0839%	
2000	0	1.1	0.0	2000.4	0.279	0.0472%	
2500	0	0.9	0.0	2500.3	0.178	0.0302%	
3000	0	0.7	0.0	3000.3	0.124	0.0210%	
4000	0	0.6	0.0	4000.2	0.070	0.0119%	
5000	0	0.4	0.0	5000.2	0.045	0.0076%	

Assumptions:

1.) "B-Band" Cellular Transmitter Frequencies are 880.02 to 893.85 MHz.

2.) All exposures will be in the far-field region since the longest wavelength is 14 inches.

3.) Exposures include 64% reflected energy from the ground

4.) Calculations are worst case based on theoretical antennas that provide maximum gain for 360 degrees in the horizontal plane.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

MAR 27 1995

AIR & RADIATION BRANCH

MAR 1 1995

OFFICE OF AIR AND RADIATION

H. Patrick Wong
Chief Air Section
Environmental Resources Management
Environmental Monitoring Div., Suite 200
33 South West, 2nd Avenue
Miami, Florida 33130-1540

Dear Mr. Wong:

On February 3, 1995, you addressed a letter to the Environmental Protection Agency regarding possible health effects from cellular telephone base stations. This letter was referred to my office which has responsibility for Electromagnetic Fields (EMF) issues with the Environmental Protection Agency (EPA).

In order to address questions like yours concerning effects from exposure to non-ionizing radiation in the radiofrequency (RF) range, we have adopted a two phase approach. In Phase I, we are developing RF Exposure guidelines which will address previously identified health effects. Phase II involves working with the National Council on Radiation Protection and Measurements (NCRP) and to look at the consequences of widespread use of modulation upon existing exposure limit recommendations.

The RF Exposure Guidelines will be completed by the summer of 1995. Our approach is based upon existing health effects information and focuses upon well established health risks. The Guidelines of the NCRP, the Institute for Electrical and Electronics Engineering (IEEE), and the World Health Organization (WHO). This approach was first articulated in the comments EPA provided to the Federal Communications Commission (FCC) on that agency's Proposed Guidelines for Evaluating the Environmental Effects of Radiofrequency Radiation. To assist in this effort, EPA formed an interagency workgroup comprising the Food and Drug Administration (FDA), the FCC, the National Institutes of Occupational Safety and Health (NIOSH), the Occupational Safety and Health Administration (OSHA), and the National Telecommunications and Information Agency.

To address more problematic concerns such as the possible impact of modulation, EPA commissioned the NCRP to conduct a two-year study. The study will result in an official NCRP report focusing on the impact of modulation upon the use of specific absorption rates (SAR) as a

measure of dose. The NCRP report will provide the basis for revision of the RF Exposure Guidelines, if warranted. EPA will also closely follow other health effects research, particularly the efforts underway by the Science Advisory Group on Wireless Technology.

The concern in Dade County over cellular base stations is similar to questions we receive from throughout the United States. Typically, cellular telephone base stations have emission levels well below the levels addressed by RF Exposure Guidelines planned for summer of 1995. The Guidelines, as noted above, are based upon health effects identified at this time. EPA must await the outcome of the research efforts underway by NCRP and others before issues associated with any as yet unidentified health effects from cellular base stations can be effectively addressed.

Finally, your letter referred to "an on-going EPA study [that] has demonstrated ground level power density measurements well below the levels which might be expected to cause either thermal or non-thermal effects." EPA has not conducted any study which concluded that there is a level at which there cannot be any non-thermal effects, nor are we aware of any peer reviewed study which reach that conclusion. We do agree with your observation that cellular telephone base stations typical have a ground power density similar to or lower than other RF based technologies such as television and radio broadcast.

Sincerely,

/s/ E. Durman for

E. Ramona Trovato, Director
Office of Radiation and Indoor Air

bcc: P. Wagner
D. O'Connor

ORIA:RSD:DOCONNOR:dh:02-22-95:6603J:x233-9340

Exhibit 7

POTENTIAL PUBLIC HEALTH RISKS FROM WIRELESS TECHNOLOGY: RESEARCH AGENDA FOR THE DEVELOPMENT OF DATA FOR SCIENCE-BASED DECISIONMAKING

Scientific Advisory Group

on

Cellular Telephone Research

August 25, 1994

SCIENTIFIC ADVISORY GROUP
ON CELLULAR TELEPHONE RESEARCH

An Open Letter From SAG Chairman Dr. George Carlo
Upon Release Of The Research Agenda On Cellular Telephones
August 31, 1994

Dear Colleague:

As Chairman of the Scientific Advisory Group (SAG) on Cellular Telephone Research, I am pleased to present the following research agenda for the research program on portable cellular telephones and other wireless communications instruments. The agenda, which includes the input of more than one hundred scientists, academics and federal regulators, has been eighteen months in the making. To ensure scientific rigor, the document has been subjected to a scientific peer-review process coordinated by the Center For Risk Analysis of the Harvard University School of Public Health.

Potential Public Health Risks from Wireless Technology: Research Agenda for the Development of Data for Science-Based Decisionmaking is a blueprint for the development of health science data on cellular telephones and other wireless communications instruments. As we gain additional information, through additional scientific input, new technological advances and the reporting of research results, the agenda will be continually updated.

I would like to take this opportunity to again thank all those who offered advice and guidance to the SAG over the past eighteen months. As we move forward into the implementation of this scientific program, our goal will be to identify any public health risk associated with wireless instruments and to suggest the best course of action to mitigate any such risks.

Sincerely,

George L. Carlo, Ph.D., M.S., J.D.
SAG Chairman
Washington, DC

1711 N Street, NW, Suite 200, Washington, DC 20036
(202) 833-2800 *telephone* • (202) 833-2801 *facsimile*

Report of the U.S. Food and Drug Administration Center For Device and Radiological Health, Radiation Biology Branch, 1993. Has appeared in Appendix 5 of Potential Public Health Risks From Wireless Technology: Research Agenda for the Development of Data for Science-Based Decision Making, August 1994, published by Scientific Advisory Group on Cellular Telephone Research (now Wireless Technology Research L.L.C. 1711 N Street, N.W. Washington D.C., tel: (202) 833-2800 fax:(202)833-29891

TAB A

CURRENT STATUS: MICROWAVES AND CANCER
A SUMMARY PREPARED BY THE RADIATION BIOLOGY BRANCH, CDRH, FDA

The literature contains reports of probably thousands of experiments relating to microwave bioeffects. Very few of these are relevant to the question of whether microwaves can in some way accelerate the development of cancer in humans. This is because endpoints other than cancer were examined in most of the studies; many examined behavioral effects, cataract development or thermoregulation. In addition, many of these studies involved acute exposures to relatively high levels of microwaves. For the types of exposures involved with devices such as cellular phones and police radar, long-term exposures to much lower power levels are of interest. The majority of the reported experiments also involved exposures at 2450 MHz, the "oven" frequency; higher and lower frequencies are employed in police radar and cellular phones, respectively. In spite of these caveats, there are a few reported experiments which bear directly on the question of cancer progression and chronic, low level exposures. This small and incomplete database strongly suggests that under at least some circumstances these exposures do indeed accelerate the development of cancer by some unknown mechanism.

IN VIVO EXPERIMENTS

Of approximately eight chronic animal experiments known to us, five resulted in increased numbers of malignancies, accelerated progression of tumors, or both. One of the experiments (1), conducted thirty years ago, involved relatively high level exposures and suffered from a number of problems, including an outbreak of pneumonia requiring in the mouse colony. For these and other reasons relatively little weight can be given to these data, but the exposed animals did exhibit an abnormal proliferation of lymphoid tissue suggestive of premalignant changes.

A much more suggestive study is that of Chou et al. (2). Financed by the Air Force, this well planned and executed study was intended to examine a number of biological, behavioral and biochemical endpoints. Two groups of 100 rats each were used; the exposed group was treated with a pulse-modulated waveform for 22 hours each day over a period of two years. Although no one type or anatomic site of tumor predominated, 18 of the exposed animals developed a malignancy of some type versus only 5 of the control animals, statistically significant at the $p = 0.001$ level. In addition, 7 of the exposed animals developed "benign" pheochromocytomas versus only one of the control animals, also highly significant ($p = 0.02$). Although this study has been discounted by some critics because no one tumor site or target organ predominated, this is precisely what one would expect for

an agent which accelerates the progression of naturally occurring malignant cells. That is, any transformed neoplastic group or cells occurring in an organ will be promoted without preference as to site or type of tumor. These results suggest that adverse health effects could possibly be caused by cellular telephones because the rate of microwave energy deposition in the rats' bodies is comparable to that of users of cellular phones and other portable communications equipment. The study's applicability to these devices may be questioned, however, on the grounds that the frequency is three times that used in cellular phones and the modulation is also different. The experiment used microwaves which were amplitude modulated while cellular telephones employ frequency modulation. Knowledge of microwave bioeffects is insufficient to allow an assessment of whether this would make a difference in the possible tumor promoting effects.

Szmigielski et al. (3,4,5) published reports of experiments using three different models of tumor progression. One group used a strain of mice with a high rate of spontaneous mammary tumors, a second group had the chemical carcinogen 3,4-Benzopyrene applied to their skin, and a third group was injected with sarcoma cells which resulted in pulmonary tumors. Animals were exposed to 2450 MHz unmodulated microwave radiation two hours a day for several months. Two different power levels were used in these experiments. All groups showed earlier appearance and accelerated growth of tumors, suggesting a tumor promoting activity. In addition, the mice exposed to higher levels developed tumors at a faster rate than the group receiving less radiation.

The only study reported in the peer-reviewed literature that did not show accelerated tumor progression (6) used mice with melanomas subcutaneously implanted under their skin. Exposure to 2450 MHz microwaves (both unmodulated and pulsed) for 2.5 hours a day did not effect tumor progression or survival times. One reason that this study may have given a negative result is that the mice only lived about 6 weeks after implantation of the highly malignant melanoma cells, dying of the effects of the tumor. The Szmigielski data shows that about 4 months of exposure is necessary before tumor progression is accelerated by microwaves. The melanoma implanted mice thus did not survive long enough for their disease to be accelerated by the microwave exposure.

IN VITRO EXPERIMENTS

Although the animal experiments described above offer the strongest evidence implicating the ability of microwaves to promote cancer, other evidence exists in the form of in vitro data. A standard method for screening chemical agents for the ability to promote neoplastic transformation employs cells in culture. This technique has been applied to microwave radiation by Balcer-Kubiczek and Harrison (7,8,9) who found that although 2450 MHz microwaves alone did not cause malignant transformation

in their system, low level microwave irradiation did increase the amount of transformation caused by TPA, a phorbol ester tumor promoter. Furthermore, the magnitude of this effect increased with increasing microwave power level, strongly suggesting that it is not an artifact. It must be noted that the microwaves used in this study were modulated at 120 Hz, due to sinusoidal ripple from the power supply, raising the question of whether the observed effect could actually be due to the lower frequency component.

A number of other in vitro experiments also suggest that low level microwave irradiation can interact with the cell's growth control mechanisms in ways that could be harmful. Byus et al. (10) has demonstrated the ability of modulated microwaves to increase cellular ornithine decarboxylase, an enzyme that is also induced by chemicals known to be cancer promoters. Czerska and colleagues (11) have similarly found that microwave exposure can induce the transformation of human lymphocytes, but pulsed microwaves are more effective than unmodulated microwaves. Dutta and Verma (12,13) have found that very low level irradiation can induce oncogene expression in cultured neuroblastoma cells, but this work has been published only in abstract form. Cleary et al. (14) has demonstrated that irradiation can induce the proliferation of cultured glioma cells, and that the effect persists for several days after irradiation, but the published experiments involved power levels greater than those likely to be encountered with cellular phones and similar devices. A number of other experiments have demonstrated genetic abnormalities, such as chromosome despiralisation (15), but many of these studies used crude exposure systems and dosimetry, and some of the reported effects may have been due to heating and not microwave exposure per se. None of these in vitro studies by themselves prove that microwaves promote tumors, but taken together they support the findings of the animal studies discussed above.

SUMMARY

Most of the published microwave bioeffects literature describes experiments that are not relevant to the question of whether microwaves can accelerate cancer progression. In particular, very few chronic, low level animal exposure experiments have been done. It should be noted that most of the experiments described above have not been replicated, and most were conducted with frequencies and modulation different from cellular phones. The fact remains, however, that the data which exists strongly suggests that microwaves can, under at least some conditions, accelerate the development of malignant tumors. This in vivo data is also supported by in vitro data which has demonstrated not only malignant transformation but other effects on the cell's growth control mechanisms. Taken together, these two lines of evidence make a compelling case for further research to either confirm or refute the previous work.

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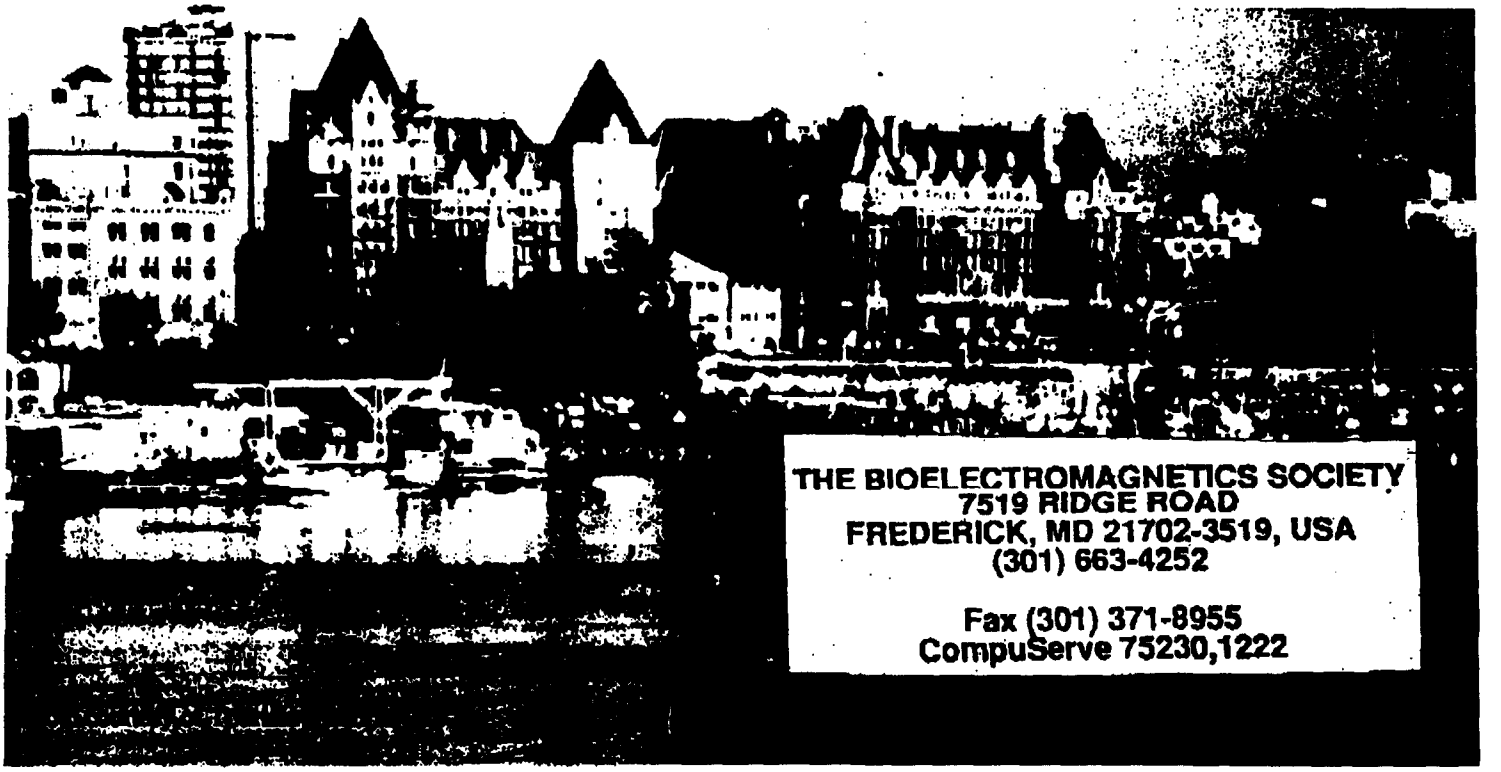

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BRAIN TUMOR INCIDENCE IN RATS CHRONICALLY EXPOSED TO DIGITAL CELLULAR TELEPHONE FIELDS IN AN INITIATION-PROMOTION MODEL.

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Risk ratios > 10 for malignant brain tumors have been reported in microwave workers after 20 years' occupational exposure in environments with electronic solvents or soldering fumes. Portable cellular phones produce near-fields at the user's head with surface incident energies around 1mW/cm^2 in the 800 MHz spectrum. Digital phone systems, replacing older FM technology, operate in a packet mode, producing pulsed fields at the user's head (North American Digital Cellular (NADC) standard, 50/sec, 33% duty cycle). Body tissues absorb up to 40% of the radiated signal.

OBJECTIVE: Since this mode of personal communication is expected to be life-long, it will be important to evaluate possible brain tumor risk in suitable animal models. We have therefore sought evidence of brain tumor promotion by digital phone fields in rats exposed to a single dose of the short-lived carcinogen ENU *in utero*, and thereafter, exposed intermittently to digital phone fields for 24 months. (Mean life span 26 months). Low ENU dosage was selected to give maximum sensitivity to possible tumor promotion by phone fields over the lifetime of the animals.

METHODS: We tested an 836.55 MHz signal with a 3:1 multiplexed TDMA (Time-Division-Multiple-Access) modulation conforming to the NADC standard: Pregnant Fischer 344 rats were randomly assigned to 4 groups. They received either a single tail-vein injection of the carcinogen ethyl nitrosourea (ENU, 4mg/kg) or inert buffer solution on pregnancy Day 18. Far-field exposures (horn radiator, 836MHz circularly polarized) began on Day 19 and continued after parturition until weaning at age 23 days. Offspring ($n = 236$) of the 4 maternal groups then became treatment cohorts: 1) ENU/Field (EF), n=56, 30M, 26F; 2) ENU/Sham (ES), n=60, 30M, 30F; 3) Sham/Field (SF), n=60, 30M, 30F; 4) Sham/Sham (SS), n=60, 30M, 30F. Near-field exposures simulating user's head began at 35 days, and continued for the next 22 months, 4 days weekly. Exposures were for 2h daily, field-on 7.5 min, field-off 7.5 min. Far-field time-averaged SARs (modeled): pregnant dam (uterus) 0.3W/kg; fetus (brain) 0.29W/kg; isolated pup (brain) 0.035W/kg; young rat (brain) 0.13W/kg. Time-averaged near-field thermographic SARs: larger males, 0.75W/kg (1.0W/kg localized maximum); smaller females, 0.58W/kg (0.75W/kg localized maximum). Survivors (n = 182, 77%) of the original 236 rats were sacrificed at age 709-712 days.

RESULTS: The TDMA field had no enhancing effect on incidence, type or location of spontaneous nervous system tumors. At experiment termination, the TDMA field appeared to reduce incidence of brain malignant glial cell tumors in Group EF vs Group ES (4 vs 13). The TDMA field also appeared to reduce incidence of spontaneous glial tumors in Group SF vs Group SS (2 vs 7). Tumors in exposed rats were smaller in volume. There were no gender differences in tumor incidence. In rats not surviving to full term (n = 54, 22%), the TDMA field appeared to prolong latency of appearance of both spontaneous and ENU-induced glial cell tumors, but did not alter histological criteria of tumor types. In comparison of survival rates, consistent nonsignificant differences were noted between groups throughout the experiment: higher death rates were in a progression SF-SS-EF-ES.

DISCUSSION: Small experimental numbers emphasize caution in interpreting these data. However, all findings are clear and consistent in showing no tumor-enhancing field effect. Our experiment design and low ENU dosage were predicated on a promotional field effect. Therefore, apparent "protective" field effects do not gain statistical support. ENU has a brain half-life of 8-10 min and causes irreversible alkylation of DNA 0-6 guanine. Ionizing radiation at the time of rat ENU dosage has been reported to reduced brain glial tumor incidence. Consistent with that model, an interpretation of this study may suggest an action of TDMA fields in mechanisms of DNA repair.

This study was supported by the Motorola Corporation.

leveloped later, is more effective at restoring normal sleep somniacs without causing drowsiness."

While it is not clear how LEET works, Pasche suggested he signals could affect the release of chemicals linked to), including calcium and melatonin. The patent cites work in the 1970s by Dr. Ross Adey of the VA Hospital in a Linda, CA, and Dr. Carl Blackman of the Environmental ection Agency in Research Triangle Park, NC, on the move- t of calcium across the cell membrane by ELF amplitude- ulated RF radiation.

Whether different waveforms and frequencies affect hu- sleep differently will need to be assessed in other studies," he cautioned.

ndeed, other types of signals could have a negative effect leep. For instance, a paper published earlier this year by Klaus Mann and Joachim Röschke of the University of nz in Germany found that sleep quality actually deteriorated ng those exposed to pulsed microwaves mimicking sig- from digital mobile radio telephones.[5] These results were announced two years ago (see *MWN*, M/J94).

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Surprising Results in First Cellular Phone Animal Study: Digital Signals Appear To Protect Against Brain Tumors

Could using a cellular phone actually protect you from de- oping a brain tumor? This is a possible implication of a long- n rat exposure study by Dr. Ross Adey of the VA Hospital in na Linda, CA. Adey found that rats exposed to microwave iation designed to mimic signals from a digital phone had fewer l smaller central nervous system tumors than control animals.

"One may speculate that the digital microwave signals may increasing the efficiency or rate of DNA repair, or perhaps h," Adey told *Microwave News*. He was quick to point out, wever, that his study was designed to test whether micro- ves are tumor promoters, so he could not make any deduc- ns about a possible beneficial effect.

Adey will present his results on June 13 at the *18th Annual eting of the Bioelectromagnetics Society* (BEMS) in Victoria, nada. The five-year study was sponsored by Motorola Inc.

Rats were exposed to 0.58-0.75 W/Kg, 836 MHz radiation lsed to match the North American Digital Cellular standard type of TDMA signal) for two hours a day, four days a week r 23 months. During the two-hour exposure period, the sig- ls were turned on or off every 7.5 minutes, so the total mi- crowave exposure was four hours a week.

Four groups of animals, each with approximately 60 rats, were used in the experiment. Prior to exposure and while still in their mothers' wombs, two groups of rats were given a single dose of the carcinogen ENU. One of the ENU groups and one of the carcinogen-free groups were exposed to microwaves.

Only four of the rats that were dosed with both ENU and microwaves developed brain or spinal cord tumors, as compared to 13 among the ENU-only rats. Similarly, among the two groups of ENU-free rats, there were only two rats with central nervous system tumors among those exposed to the cellular phone radiation, as compared to seven rats among those that were not.

Adey's results are a mixed blessing for Motorola and the rest of the cellular phone industry, according to one observer who asked not be identified. "There are two interesting points," the source commented. "On the one hand, the data indicate that there *was* an interaction between the rats and the TDMA signal, apparently a protective effect. But, on the other hand, in the absence of a mechanism to explain this effect, we cannot assume that there will be a similar response for other power densities, other exposure regimens and other radiofrequency signals. The take-home lesson is that many more experiments are needed to better understand how modulated microwaves affect living systems."

A second animal study using frequency-modulated (FM) microwaves similar to those from analog cellular phones is nearing completion at Adey's lab.

Also working on the animal studies were Dr. Craig Byus of the University of California, Riverside, Dr. Niels Kuster of the ETH in Zurich, Switzerland, and members of Adey's lab.

A spokesperson for Motorola declined to comment on Adey's results before they are presented at BEMS.

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Exhibit 8

Biologic Effects and Health Hazards of Microwave Radiation

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THE BIOLOGIC ACTION AND HYGIENIC SIGNIFICANCE OF ELECTROMAGNETIC FIELDS OF SUPERHIGH AND ULTRAHIGH FREQUENCIES IN DENSELY POPULATED AREAS

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With the powerful development of television, radar, radioastronomy and radiometeorology, hygienists are faced with a number of tasks, one of which is the assessment of energy of ultrahigh (UHF) and superhigh (SHF) ranges in densely inhabited areas. Until recently these ranges of radiofrequencies were investigated by hygienists only from the point of view of industrial hygiene and occupational diseases, while the problems of the biologic action and hygienic significance of UHF and SHF ranges, in relation to public hygiene, remained insufficiently elucidated. Taking this into account, we performed special investigations both on the distribution of electromagnetic energy in the UHF and SHF ranges under modern urban conditions and on the biologic effects of this energy.

Results of these investigations showed that at sites where television transmitters, TV links and radar stations are placed, the intensity of electromagnetic energy is much higher than that of the earth's background and covers a wide range, depending on the capacity of the emitters and the distance from radiating devices (antenna). Electromagnetic energy of various intensities penetrates living, administrative and other buildings located in the vicinity of the sources of radiation.

In order to assess the biologic action of the defined intensities of electromagnetic energy, as well as the hygienic importance of such radiation in densely populated areas, experimental studies on animals were conducted. Investigations were performed in shortened wave guides within the ultrahigh frequency range (wavelength 6 m) at the following power densities: 10, 2.4, 1.9, 0.06, 0.01 and 0.0006 $\mu W/cm^2$. Within the range of superhigh frequencies, irradiation was carried out at a distance which corresponded to the following power densities: 10, 5, 1 and 0.5 $\mu W/cm^2$ (continuous generation, 12 cm wavelength) and 10, 5, and 1 $\mu W/cm^2$ (pulsed generation, 3 cm wavelength, pulse duration $\tau = 1$ μsec and 1000 and 20 pulses per second).

In addition, using the pulsed regime of irradiation, the movements of the radar antenna were imitated with a beam angle of 2° and a rotation frequency of 10 revolutions per minute.

The computed intensities were close to those encountered in areas adjacent to television transmitters, links and radar systems.

The intensity of electromagnetic energy during experiments was controlled with IEMP-1 and PTSH-5A instruments for the UHF range and PO-1 ("Medik") for the SHF range.

Investigations of biologic effects for the UHF range were conducted on 128 white rats and 28 rabbits, and for the SHF range on 100 white rats and 32 rabbits. The ani-

mals were irradiated daily for 10—12 h with electromagnetic energy in the UHF range and for 8 h in the SHF range. For each range and each intensity, the duration of the experiment amounted to 180 days (120 days of irradiation and 60 days of follow-up).

The results showed that the action of the electromagnetic field both in the UHF and SHF ranges during the first 10—12 days of irradiation resulted in some changes in the general status of the organism. Within this period the animals were somewhat excited and reacted to switching-on of the electromagnetic field.

These findings substantiated the notion that, as a result of the action of the electromagnetic energy, certain changes in the central nervous system were elicited. In order to define the changes more closely, investigations of the conditioned reflex activity of the animals were performed.

These experiments showed that, under the action of UHF and SHF fields, certain periodic changes appeared in the conditioned reflex activity of the animals. On the whole, the latent period was longer, reflex reactions to positive stimuli weakened, and the number of those missing increased. All this was evidently connected with the development of consequent inhibition related to impairment of nervous reactivity, and leading to pathologic stagnation and inertia. The intensities which produced statistically significant changes were 1.9—10 $\mu W/cm^2$ and 5—20 $\mu W/cm^2$ in the UHF and SHF ranges, respectively.

These data were supplemented by electroencephalographic studies conducted on rabbits. The dynamics of changes in the central nervous system were assessed, as reflected in bioelectric activity of the brain cortex. The results showed that in the investigated rabbits the action of electromagnetic energy elicited some disturbances in relations between the potential frequency groups of the cortex (Tab. 1). At the beginning (2—14 days), activition of the biocurrents in the brain was observed, testifying

Table 1

Changes in biocurrents in the brain cortex of rabbits under the influence of electromagnetic energy of UHF range

Groups of animals and field intensity	Rhythms of biocurrents	Periods of examination				
		Before irradiation	2 days later	10 days later	30 days later	60 days later
Group I 10 $\mu W/cm^2$	Slow	26.0±1.8	11.0±1.8	6.0±1.6	17.0±2.9	58.2±5.1
	intermediate	50.1±1.7	34.0±4.1	24.5±2.7	54.2±3.3	27.2±1.9
	fast	23.1±0.6	55.0±5.8	72.0±1.7	29.8±0.7	11.6±3.1
Group II 1.9 $\mu W/cm^2$	Slow	19.0±2.1	11.5±1.0	16.0±1.7	12.8±2.2	52.0±2.7
	intermediate	66.4±3.2	72.0±3.3	46.0±8.5	65.0±3.9	38.8±4.8
	fast	14.2±1.6	16.5±2.5	44.0±9.7	22.2±4.6	9.2±2.3
Group III 0.01 $\mu W/cm^2$	Slow	18.7±1.4	19.0±1.6	17.5±1.7	14.0±1.2	22.5±1.4
	intermediate	70.2±0.9	70.0±2.2	68.5±2.9	69.5±2.4	65.0±2.9
	fast	10.5±0.9	11.0±1.7	14.0±1.9	11.0±1.7	11.5±2.2
Controls	Slow	17.2±1.4	17.2±1.4	14.8±0.7	14.2±0.8	16.0±0.4
	intermediate	65.7±2.4	67.7±2.4	68.2±1.4	70.7±1.8	67.8±0.4
	fast	16.6±1.2	16.6±1.2	17.0±2.0	15.5±1.9	16.2±0.7

to some increase in the excitation process. With increasing duration of exposure an initial stage of inhibition developed, characterized by synchronization of the cortical rhythms. Thus, upon prolonged irradiation, the strength of the process of inhibition within the brain hemisphere cortex was appreciably increased, as evidenced by the appearance of slow rhythms in the electroencephalograms. The observed changes in bioelectric activity of the brain cortex of rabbits confirmed previously reported results of studies on conditioned reflex activity of animals and showed that electromagnetic energy in the UHF range and 0.06—10 $\mu W/cm^2$ intensity, as well in the as SHF range and 5—20 $\mu W/cm^2$ intensity, was indeed active biologically according to the results of statistical analysis.

Bearing in mind that electromagnetic fields of radiowaves act predominantly on the central nervous system, our biochemical studies concentrated on those indicators which directly or indirectly characterized the functional activity of the nervous system. Such tests in our investigations included cholinesterase activity and sulphydryl (SH) groups in the blood.

These experimental investigations showed that electromagnetic fields in the UHF and SHF ranges appreciably lowered blood cholinesterase activity and quantity of SH groups (Tab. 2 and 3). It could be noted that with increasing duration of exposure to the field, inactivation of SH groups in the blood also increased. It could therefore be assumed that a lowered activity of both cholinesterase and SH groups in the blood, as induced by the action of UHF and SHF electromagnetic energy, resulted in impairment of the biochemical mechanisms which ensure the normal course of nervous processes in the animal organism. Such was the likely explanation of the

Table 2

Changes in certain indicators of metabolic processes in rats exposed to UHF electromagnetic energy in chronic experiments

Indicator	Group I, 10 $\mu W/cm^2$				Group II, 1.9 $\mu W/cm^2$				Group III, 0.01 $\mu W/cm^2$			
	Before irradiation	30 days later	90 days later	120 days later	Before irradiation	30 days later	90 days later	120 days later	Before irradiation	30 days later	90 days later	120 days later
Blood cholinesterase activity, ΔA/min	154	121	84	98	154	152	108	101	156	152	151	173
±S.D.		3.8	7.2	5.0		0.3	6.0	6.9		0.4	0.5	1.9
Blood SH groups, μmol/100 ml	1697	1750	1410	1190	1500	1340	1030	857	1702	1537	1587	1550
±S.D.		0.8	4.0	6.6		3.1	7.3	10.8		1.8	0.8	0.5
17-ketosteroids, in urine, mg/24 h	0.019	0.032	0.055	0.060	0.018	0.024	0.040	0.047	0.021	0.018	0.022	0.023
±S.D.		8.6	19.4	16.4		2.7	8.4	10.4		0.7	1.2	0.4

Table 3

Changes in certain indicators of metabolic processes in rats exposed continuously to SHF electromagnetic energy in chronic experiments

Indicator	Group I, 10 μW/cm²				Group II, 5 μW/cm²				Controls			
	Before irradiation	30 days later	90 days later	120 days later	Before irradiation	30 days later	90 days later	120 days later	Before irradiation	30 days later	90 days later	120 days later
Blood cholinesterase activity, ΔA/min	123	142	110	104	125	134	110	110	123	122	122	147
P		<0.05	<0.05	<0.05		<0.05	<0.05	<0.05				
Blood SH groups, μmol/100 ml	1411	1694	1320	1340	1427	1640	1340	1350	1461	1461	1527	1533
±S.D.		5.7	2.5	2.2		3.6	2.8	2.9		0	1.0	1.1
17-ketosteroids in urine, mg/24 h	0.0225	0.0375	0.0368	0.0343	0.0230	0.0380	0.0375	0.0420	0.0230	0.0256	0.0243	0.0213
P		<0.05	<0.05	<0.05		<0.05	<0.05	<0.05				
RNA in the liver	—	—	—	70.2	—	—	—	71.4	—	—	—	89.3
±S.D.	—	—	—	4.9	—	—	—	3.6				
DNA in the liver	—	—	—	51.5	—	—	—	51.0	—	—	—	70.7
±S.D.	—	—	—	5.0	—	—	—	5.0				

changes which we found in conditioned reflex and bioelectric activities of the brain cortex of irradiated animals.

It is well known that steroid adrenal hormones, weight of the suprarenal glands and their ascorbic acid contents are all important biochemical parameters of metabolic processes of the human and animal organism. These parameters characterize not only general metabolic processes of the organism, but also reflect certain relations between biochemical reactions and the functional status of the nervous system, and are therefore of particular interest.

Our results showed that prolonged action of electromagnetic fields of UHF and SHF frequencies resulted in increased weight of the adrenals, a reduction in their ascorbic acid content and increased secretion of 17-ketosteroids in the urine of experimental animals. The above changes could probably be explained by an increased functional activity of the hypophysis-adrenal cortex system. It is widely accepted that activation of the cortical function points to an influence of unfavourable conditions, so-called stress stimuli, acting upon the whole organism. In this case we considered

electromagnetic fields in the UHF and SHF ranges to be such unfavourable stimuli. The lesions occured in animals irradiated at power densities of 0.06 to 10 and 5 to 20 $\mu W/cm^2$ with UHF and SHF electromagnetic fields, respectively.

While investigating the biologic influence of electromagnetic fields in the SHF range, we tried to define the action of this factor upon the endocrine system and took as an example the thyroid gland. In order to asses the functional status of the thyroid, use was made of the radioactive iodine indicator method (uptake of radioactive iodine by the thyroid gland) and the method employing ^{131}I-thyroxine. These investigations showed that under the influence of SHF fields of 10, 5 and 1 $\mu W/cm^2$ power density, the ability of the thyroid gland to concentrate radioactive iodine was increased: the maximum uptake amounted to 48.0 $\pm$ 1.88 at 10 $\mu W/cm^2$, 51.2 $\pm$ 4.03 at 5 $\mu W/cm^2$, and 51.1 $\pm$ 6.0 at 1 $\mu W/cm^2$, as compared with 28.3 $\pm$ 3.38 in control animals. This testified to the fact that SHF energy induced intensification of thyroid function. Taking into account that the thyroid gland has a regulatory influence on a number of functions of the organism, one could imagine that an increase in its activity induced a number of undesirable changes in the organism as a whole.

The above investigations were accompanied by studies on the morphologic composition of the blood. It was found that electromagnetic energy in the UHF and SHF ranges caused an insignificant decrease in the number of leukocytes, eosinophils and reticulocytes; some tendency to lowered erythrocyte and hemoglobin values was also observed.

Bearing in mind that electromagnetic fields influence general metabolic processes, we performed investigations on the effects of this factor on nucleic acid metabolism. Results of these investigations showed that the factor under study induced a statistically significant increase in the RNA and DNA contents of the spleen and liver of the animals (see Tab. 2). It is difficult at present to explain these findings. To solve this problem, special investigations will be needed.

In addition, we studied the influence of electromagnetic energy in the UHF range upon carbohydrate-phosphorus metabolism. These investigations showed that a prolonged exposure to a field of 0.06—10 $\mu W/cm^2$ intensity resulted in disturbances of glycogen metabolism, i.e. a reduction in the glycogen content in the liver due to increased phosphorylase activity accompanied by simultaneous accumulation of lactic acid. At the same time a marked influence of UHF fields on oxidative coupling and phosphorylation processes in rat liver mitochondria was detected. Long-term irradiation led to a fall of phosphorylation and oxidation functions of hepatic mitochondria.

The biologic experiments were complemented by histomorphologic studies which showed that the lesions which appeared under the influence of electromagnetic energy in the UHF and SHF ranges took the form of dystrophic changes in the brain, liver, spleen and testes, along with impairment of blood circulation. The severity of these changes depended on the intensity of the electromagnetic field. More pronounced changes were found in the organs of animals exposed to relatively high intensities.

Analysing the results of the above experimental investigations, it should be noted that prolonged action of electromagnetic energy of low intensities in the UHF and SHF ranges resulted in appreciable changes in the general status of the organism, conditioned reflex activity, bioelectric activity of the brain cortex, a number of biochemical parameters, blood composition and morphologic structures of the tissues and organs of the animals under study. The biologically active intensities of electromagnetic fields were 10—0.06 and 20—5 $\mu W/cm^2$ for UHF and SHF ranges, respectively.